

REQUEST FOR PROPOSAL

***Optical Telescope
under
NETRA Project***

January 2020

**LABORATORY FOR ELECTRO-OPTICS SYSTEMS (LEOS)
INDIAN SPACE RESEARCH ORGANIZATION
PEENYA INDUSTRIAL ESTATE,
BANGALORE 560 058
INDIA**

Contents

1. Introduction.....	4
2. Scope	4
3. Technical Specifications	6
3.1. Telescope.....	6
3.2. Tracking mount.....	8
3.3. CCD Camera.....	10
3.4. Dome	11
3.5. Time and Frequency Standard	12
3.6. Weather Station.....	12
3.7. Operating System with Software Requirements	13
3.8. Interface Requirements	14
3.9. Electrical Support System.....	15
4. Detailed Design Review (DDR)	15
5. Pre-Shipment Acceptance Tests	16
6. Installation, Commissioning and Site Acceptance Test.....	16
7. Support infrastructure and Essential Spares	17
8. Quality Standards.....	18
9. Major Milestones	18
10. Training	20
11. Warranty.....	21
12. Documentation	21
13. Monitoring and Coordination	22
14. Vendor Heritage	22
15. Quotation format.....	22
16. General Instructions, Terms and Conditions.....	23
Annexure-I	27
Annexure-II	28

Abbreviations

1	Alt-Az	Altitude-Azimuth
2	CCD	Charge Coupled Device
3	EFL	Effective Focal Length
4	FOV	Field Of View
5	GEO	Geostationary Earth Orbit
6	GPS	Global Positioning System
7	GUI	Graphical User Interface
8	API	Application Program Interface
9	INCOTERM	International Commercial Terms
10	ISRO	Indian Space Research Organization
11	LEOS	Laboratory for Electro-Optics Systems

1. Introduction

NEetwork for space object **TR**acking and **A**alysis (**NETRA**) is the first ISRO project with the primary objective as Space Situational Awareness (SSA). The prime goal of the project is to establish a network of observational facilities and a control centre, to identify, track and catalogue space objects that threaten the safety of Indian space assets. The control centre will process the tracking information from the observational network and provide accurate & timely proximity alerts to mission operations centre.

For this purpose, ISRO invites proposals for the supply, installation and commissioning of Optical Telescope System with all the necessary mechanical, electrical, electronic and software systems for the above-mentioned applications.

The location for establishing the optical telescope facility is identified as Hanle, Ladakh in INDIA.

It is intended that a one-meter optical telescope with a high-resolution CCD camera should provide capability of detecting space objects **of size 30 cm and above** in Geo-Synchronous Orbit (GSO).

ISRO invites proposals from reputed vendors who have requisite experience in this field to design, manufacture, install and commission the total system **end-to-end** in Hanle, Ladakh. The total system will be known as **Netra Telescope**.

2. Scope

The Vendor should quote for one number, end to end photometry system as per the technical specification given in section-3, comprising the optical telescope, tracking mount, CCD Camera, Dome, Weather station and all related hardware and software.

This document provides the detailed specifications of the proposed photometry system. While some of the specifications like telescope aperture, accuracy, range are major specifications (mentioned as major are not variable), the other parameters like size, f/#, etc., define one possible configuration of the system which shall be tailored to meet the overall system requirements (mentioned as typical in the specification table).

The primary function of the facility is satellite photometry. Telescope system for this purpose will be established at the location mentioned below:

Location : Hanle, Ladakh, INDIA (a site with green protocol)

Altitude : 4500m

The telescope facility is to be designed such that it can be used for easy scan of space objects **of size 30 cm and above.**

The vendor should have sufficient experience to carry out installation and commissioning of equipments of similar photometry telescope system. Vendor should enclose technical details of end-to-end optical telescope installations and deliveries carried out to support their qualification.

The vendor is expected to carry out complete installation and commissioning of the telescope at the identified site. Therefore, vendor should identify all the hardware essential for satisfactory operation of the telescope in the offer. The necessary civil construction shall be carried out by ISRO as per the requirements indicated by vendor pertaining to foundation and dimensions. For this purpose, the preliminary details required for civil works need to be provided in the offer. The steel support structure for dome along with the Dome shall be the responsibility of the vendor.

The facilities are proposed to be remotely operated from BENGALURU, INDIA. For this purpose, the necessary communication link shall be established by ISRO. However, the vendor shall provide necessary details of communication requirements, bandwidth required for operation. The software shall have provision for complete remote operation of telescope without manual intervention. The necessary hardware and software interface shall be incorporated in the system configuration.

For uninterrupted operation of telescope, the necessary requirements shall be defined as well as the power requirements (primarily solar power at the site) including UPS and power back up time. The uninterrupted power supply/generator shall be provided by ISRO based on the inputs provided. The necessary software interface shall be provided for switching off the system in case of prolonged power failure.

The Electronic system shall be protected by suitable interlock mechanism for overload and safety. Similarly, the optics, CCD camera shall have necessary protection features to protect from direct sunlight.

The vendor should provide details of pricing for each subsystem and identify optional items clearly which may be chosen to enhance the system capability. List of spares and accessories required for an uninterrupted operation of the facility, post warranty period, should be separately identified in the

commercial price breakup. Vendor should ensure trouble-free operation of the system adequately covering the delivery of spares for a period of 10 years.

3. Technical Specifications

3.1. Telescope

The specifications of the telescope system are as given below. The main requirements of the telescope are the size and the optical quality within the field of view. The focal plane should be the Cassegrain type. The entire system should be modular in nature. The vendor is expected to design and configure the telescope parameters so as to make use of the CCD camera to its full potential.

Sl. No.	Parameter	Specification	Remarks
1	Optical configuration	Ritchey-Chretien/ Cassegrain two mirror telescope (spectral band 0.4 - 0.9 micron) with field corrector optics	
2	Telescope mirrors	Primary mirror (PM) clear aperture of 1-meter diameter * Secondary mirror of suitable diameter. Manual and remote focusing provision for secondary mirror mounted on Hexapod Range ± 20 mm (typical along optical axis) Accuracy ± 5 micron. Tip/Tilt: ± 1 degree with coarse & fine adjustment	Major The Aspect ratio of PM shall be 1:8 The primary mirror shall be mounted on the passive whiffletree type mount *Physical diameter of the primary mirror may be frozen by the vendor
3	Mirror material	SCHOTT Zerodur / CORNING ULE / CLEARCERAM Thermal expansion $\leq 0.0\pm 1\times 10^{-6}/K$ over range 0-50°C	Major
4	Telescope System F #	F/9.0	Typical
5	Plate scale	22.0 arc sec/mm	Calculated for the typical values
6	Receiver Type	Focal plane CCD camera	Major
7	Field-of-view	Optimized for circular Field of view $\pm 0.3^0$ or better without vignetting	Designed for the Typical value

8	Optical Quality	RMS-WFE < 50 nm (with a goal towards 40 nm) in mounted condition (for the required EFL & FOV)	Note 1 Major
9	Optical Path Stability	15nm RMS over 0.01 arc sec field of view	By simulation using Finite-Element analysis
10	Optical efficiency	> 70% (weighted avg.) over 0.4 to 0.9 microns	Excluding detector
11	Spectral range	0.4 to 0.9 micron	Major
12	Thermal stability	Telescope structure shall be suitably designed to ensure optical performance over temperature variation of -25° C to 30°C	By analysis
13	Sunlight avoidance	by telescope control software	Note 2
14	Protection	Automatic protective cover for rain, dust, wind with remote operation capability	Shall include manual command provision
15	Optical coating	Protective Aluminum coating Conforming to MIL-M-13508 C	With minimum reflectance of 85%
16	Alignment reference	Suitable provisions to un-mount and re-mount mirror after coating with minimum realignment	Note 3
17	Calibration	Internal alignment reference for focusing/ calibration	
18	Mechanical finish	Parts blackened to avoid stray light	Reflectance to be kept less than 0.1
19	Storage condition	Designed and constructed to withstand hazards associated with the site, storage and transit	Note 4
20	Range of operating conditions	Design shall take care of the range of operating conditions specified for the selected site.	Note 4
21	Stray Light control	Suitable baffle design to be done to control stray light coming to the telescope	
22	Wide angle telescope mounting provision	The telescope mount should have mechanical interface to mount a wide angle telescope of about 50 kg weight as a piggy back to the main telescope along with the provision for balancing weight	This is for future augmentation of the facility for using in LEO debris tracking
23	Provision of tertiary mirror	Provision for a tertiary mirror in order to augment the facility to Nasmyth focus at a later stage to be available	

Notes

1. RMS Wavefront Error over the full aperture should be less than 50nm measured at 632nm.
2. Remotely actuated mirror cover. Sun sensor if required, should be provided.
3. For handling the primary mirror, necessary fixtures/gadgets are to be provided and suitable provision in the mirror mount to be made. Also suitable alignment references to be provided on the rear surface of the mirrors.
4. Environmental factors before installation (storage) and after installation (normal closed condition) are to be considered. For the selected site at Hanle, Ladakh the typical external environmental conditions are mentioned hereunder:
 - a. Temperature range -25 °C to 30 °C
 - b. Wind up to 200 kmph (worst case)
 - c. Humidity 10 to 95 %
 - d. Additional hazards like Heavy rain, thunderstorm, lightning and dust storm, hazard by small animals, insects, etc.

3.2. Tracking mount

Sl. No.	Parameter	Specifications	Remark
1	Mount Type	Alt.-Az. (Altitude axis 5 meters above ground to limit the impact of 'ground seeing')	Major Any other requirements for civil construction to be specified
1A	Mount Structure material	Stainless steel SS304L or better	Major
2	Telescope Drives	On-axis direct drives with high accuracy encoders and servo controllers	Major
3	Absolute Pointing accuracy (Computer directed)	< 2 arc sec. rms absolute (over all sky)	Major
4	Differential pointing accuracy	<0.2 arc sec. rms relative (over 10 arc min.)	Major

This document is the property of LEOS, ISRO

5	Slew rate	Azimuth ≥ 5 deg/sec, Elevation ≥ 5 deg/sec	Major
6	Acceleration and deceleration	≥ 2 deg / sec ²	
7	Blind spot for tracking	less than 0.5 deg around zenith	
8	Tracking accuracy with auto guider	< 0.2 arc sec. rms over 10 sec. < 0.5 arc sec. rms over 10 min.	
9	Tracking accuracy without auto guider (program mode)	< 0.3 arc sec. rms over 10 sec. < 1.0 arc sec. rms over 10 min.	
10	Encoder resolution	< 0.02 arc seconds	Major
11	Elevation range	-5 deg to 185 deg	
12	Azimuth range	± 200 deg	Cable wraps to be used for elevation motor connections
13	Min tracking rate	Sidereal rate	Major
14	Max tracking rate	≥ 5 deg/sec in both axes	Major
15	Tracking Jitter	≤ 0.02 arc sec for 10 to 85deg elevation	Major
16	Positioning accuracy	< 0.1 mm displacement & < 5 arc sec. angular	Major
17	Protection	Suitable limit switches - Soft & Hard switches & also emergency stop provision	
18	Telescope control	Local and remote with API and batch mode commanding S/W with provision of manual override	
19	Leveling	0.02 mm (initially) during the installation which has to be rechecked in specific intervals and to be corrected	
20	Bearing	High precision, life-time auto lubrication of bearing with proper sealing should be provided.	Major In compliance with environmental conditions in the proposed site of installation
21	Nasmyth port	The telescope mount elevation motor should have a hallow path with at least 150mm diameter in order to augment the facility for a Nasmyth port at a later stage	

3.3. CCD Camera

Sl. No.	Parameter	Specification	Remarks
1	Detectors	ANDOR (iKon-XL231) CCD camera of 4K x 4K pixels Back illuminated CCD chip (Grade-1) to be used, with 15 micron pixels; imaging area of 61.4 x 61.4 mm ² peak Quantum Efficiency of 95%	Major Note 5
2	Detection Threshold	19 th to 21 st Magnitude	Major
3	Full well capacity	3,50,000 e ⁻	
4	Exposure	0.04-3600 sec	Typical range
5	A/D gain	1.5 e ⁻ unbinned	
6	Binning	1x1, 2x2, 4x4	ROI (region of interest)
7	Dark current	<1 e ⁻ /pixel/sec at -60°C	Major
8	Tracking capability	Output compatible for track mount for tracking the target	Note 6
9	Atmospheric compensation	Tip-Tilt and refocus (initial)	
10	Detector Cooling	TE, Air cooled.	
11	Filter wheel	Provisions for various spectral filter, neutral density filter in a filter wheel for day/night observations	
12	Autofocus	S/W Provision based on star observations	
13	Calibration	Star observation correction	

Notes:

5. The CCD camera should be capable of observing the stars with the given magnitude. Higher resolution and sensitivity is preferable.
6. It should be possible to track the observed target in auto track mode within the capability of the tracking mount. Provision for programmed tracking also to be incorporated.

3.4. Dome

The vendor shall supply the dome along with the telescope system to ensure compatibility of tracking and thermal environment. The dome movements should be noise free, appropriately insulated to facilitate thermal control, and vibration-free to avoid interference with telescope operation.

Sl. No.	Parameter	Specification	Remarks
1	Dome (Enclosure) Type	Thermally insulated with sliding slit window. Material: Stainless steel SS 304L or better	Major
2	Dome support Base	Stainless Steel Structure (Vendor Design) SS 304L or better	Note 7 Major
3	Dome diameter	6 m	Typical
4	Operational wind speed	0 – 120 kmph 50 kmph (full performance except jitter)	
5	Survival wind speed	200 kmph (no damage)	
6	Operational temperature range	-25°C to 30°C (external environment)	
7	Micro Seismic activity	0.2 $\mu\text{G}/\sqrt{\text{Hz}}$ in (2-100Hz) full performance	Zone-4
8	Survival Seismic activity	$M_R = 7.75$ at 100 km / peak acceleration 0.24g (no damage)	
9	Vibration	No impact on telescope performance	
10	Dome footing	To provide minimal mechanical coupling between the dome and telescope pedestal	Note 8
11	Remote and automated control	For dome opening/closing, rotation and fast shutter closing during emergency.	
12	Rotation rate	Commensurate with the tracking speed of the tracking mount and telescope operation for satellite operations with integrated control of dome and telescope.	
13	Manual operation	Provision for manual operation of dome under power failure, rain, etc.	
14	Safety	Input data from the weather stations to be used to operate the dome safely.	

15	Dome support room structure made of stainless steel (SS 304L or better) with proper insulation	As per the typical dimensions as shown in Annexure-I to suit the proposed dome. Should meet all the environmental conditions specified for the dome (Sl. Nos.4 , 5 and 6) detailed design to be provided along with quote.	Optional Separate price bid to be provided
----	--	--	---

Notes:

7. The steel support structure and the Dome shall be the responsibility of the vendor
8. The Civil and basic structure of the building shall be responsibility of ISRO

3.5. Time and Frequency Standard

Sl. No.	Parameter	Specifications	Remarks
1	Time reference	GPS /Navic	
2	Synchronisation	GPS /Navic	
3	Epoch accuracy	< 1 nsec	

3.6. Weather Station

Telescope/dome control software shall have the weather sensor information as a feedback for safe operations.

Sl. No.	Parameter	Specifications
1	Wind Monitor	
1.1	Speed range	0-200 km /hour
1.2	accuracy	1 kmph
1.3	Wind direction	0-360 deg
1.4	accuracy	± 5 deg
2	Pressure Monitor	
2.1	Pressure range	550-1100 mbar
2.2	accuracy	0.1 mbar
2.3	stability	<0.1 mbar /year
3	Temperature Monitor	
3.1	Range	- 50 to + 70 deg C
3.2	accuracy	< 0.5 deg C
3.3	Stability	0.1 deg C /year
4	Relative Humidity Monitor	
4.1	Range	0 to 100%

4.2	accuracy	$\pm 2\%$
4.3	stability	<1% per year
5	Visibility Sensor	
5.1	Visibility range	10 m to 50 km
5.2	Cloud sensor	All sky Visible camera
5.3	Precipitation sensor	To measure the presence of fog, rain
6.	Lightning sensor	Far distance Near distance

3.7. Operating System with Software Requirements

Vendor is free to suggest the overall data flow & processing scheme, operating system and hardware. The hardware should be the latest available in the market. Adequate documentation to support any future changes shall be provided for the same. **Vendor shall provide list of all the software and hardware deliverables, functional details, mode of operation, operating system and other details which are necessary.**

Necessary software modules required for the above should be part of the system, with remote configurable and operable capability, wherever possible. These requirements are only functional requirements and vendor should provide details of the accuracies, speed, update rate, storage wherever applicable.

GUI interface as well as batch mode execution with user friendly, menu driven software is desired. The vendor may include some specific output samples in the proposal and provide a list of software packages included in the offer along with their functionality. Software upgrades and maintenance support shall be provided, wherever applicable.

The lists of typical required software are given below:

Sl. No.	Software
1	Telescope pointing based upon look angles
2	Telescope tracking
3	CCD camera target tracking
4	Photometric measurement from CCD observation
5	Atmospheric correction for measurements in pointing
6	Alerts for emergency, auto shut down, error messages
7	Auto search in a predefined grid pattern
8	Tracking the target based upon programmed inputs
9	Safety shutdown in case of power failure

10	Fully automatic remote operation with manual override capability
11	Dome operation motorized as well as manual
12	Atmospheric correction for range
13	Calibration of telescope for photometry, pointing, visual magnitude and object size
14	Software safety interlocks for mechanical systems, environment monitoring systems and other sub-systems which might cause damage to the system.
15	Time referencing of measurement
16	Environmental monitoring and reporting
17	Operations scheduling
18	Data archival, back up (with 10 TB storage capability or more)
19	Self-diagnostics and remote diagnostics
20	Thermal compensation for focusing
21	Compensation for leveling and alignment

3.7.1 The vendor should make provision for tapping of data at significant processing steps in the overall data flow & processing scheme of the system. The provision for data tapping should be remotely configurable with storage at the facility during the measurement. Data transfer provision from local storage (at the facility) to remote location should be made available.

3.7.2 All software modules for operation, data transfer, configuration, control and monitoring should be provided preferably with command interface and GUI, through local and remote connections in real-time/offline conditions.

3.7.3 All CCD frames are to be stored in FITS format & WCS coordinate system, including the metadata, in the local storage with capability to retain the information for 1 year.

3.7.4 The vendor shall also provide image-processing software to process the image output from the camera, extract the azimuth/elevation or right ascension/declination of the objects captured in the image after astrometric correction and provide the information along with time in CCSDS-TDM data file format.

3.7.5 The output of the system is required as CCSDS-TDM data file, including all the necessary auxiliary information for processing the CCSDS-TDM data file.

3.8. Interface Requirements

Suitable interface shall be provided between the facility and remote control centre as given below:

This document is the property of LEOS, ISRO

- 3.8.1 TCP/IP protocol to be used between equipment and remote control system
- 3.8.2 Interface protocol is for communication purpose (monitoring and control and Data Transfer)
- 3.8.3 Multiple access for control and data transfer

3.9 Electrical Support System and Operating Environment

- 3.9.1 The telescope and other equipments with its accessories shall operate with single phase 230 VAC (tolerance: $\pm 6\%$) or Three-phase 415 VAC (tolerance: $\pm 10\%$) power supply at a frequency of 50 Hz (tolerance: $\pm 6\text{Hz}$).
- 3.9.2 The vendor should provide the complete power supply control system from the specified customer's normal supply system, if required.
- 3.9.3 The power distribution bus should have all the necessary hardware such as fuses, relays and circuit breakers to safeguard the various subsystems and the equipment as a whole against power fluctuations, power hazard, overload and such situations that may arise during the use of equipment as per applicable standards and norms.
- 3.9.4 The equipment shall have provision of uninterrupted power supply using batteries for essential parts like program, memory, etc. In case of power failure, the observations shall not be disturbed and on resumption of power work shall continue from the point of stoppage on a SOS basis.
- 3.9.5 Air conditioning shall be provided for thermal control of the telescope and mount, etc. as per the requirements provided by the vendor.
- 3.9.6 Additional infrastructure facilities required to be specified which can be realized during site preparation.

4. Detailed Design Review (DDR)

The vendor should provide a detailed Detailed Design Review (DDR) report which should comprise of Optical, Electro-optical, Opto-mechanical, tracking mount design and overall end-to-end system specification compliance along with FE analysis of the entire mechanical system, to meet the specified system performance. The system should be designed to survive the environment condition that persists throughout the year in Hanle, the installation location.

This document is the property of LEOS, ISRO

The DDR shall be conducted after placement of order wherein the final configuration of the proposed system, testing and acceptance, installation and commissioning plan shall be provided including requirements of civil works for installation. The design will be reviewed by the committee of experts from the field constituted by ISRO and vendor should accommodate necessary changes if any suggested by the committee.

On completion of the DDR, no change in the final approved plan/ procedure will be entertained. However, under exceptional circumstances, some minor changes may be permitted with the approval of competent authority from ISRO.

5. Pre-Shipment Acceptance Tests

The vendor shall outline a test acceptance, installation and commissioning plan as part of the proposal in response to RFP. The details shall be provided at the time of detailed design review of the facility and shall be mutually discussed and agreed. The test plan shall provide the details of testing prior to shipment.

- 5.1 It is required that the individual telescope components shall be independently tested and performance established prior to telescope system integration
- 5.2 The overall telescope performance in the mounted condition shall be tested in the finalized configuration and the system performance to be demonstrated prior to shipment.
- 5.3 The test procedure protocols with test parameters and their acceptable limits shall be defined by the vendor which should be reflected in the DDR.
- 5.4 Since the pre-shipment acceptance tests are planned at the vendors/ sub-contractors premises, it is the responsibility of the vendor to make the necessary arrangements for participation of ISRO personnel at vendor's premises.
- 5.5 Equipment shall be shipped only after receipt of acceptance certificate from ISRO personnel. However, ISRO has at its discretion to waive off the requirements of participation based on test reports provided by the vendor.

6. Installation, Commissioning and Site Acceptance Test

The installation, commissioning and site acceptance tests shall be elaborately planned and presented by the vendor during DDR.

- 6.1 For installation and commissioning of the system all the necessary test equipment/gadgets for the same shall be brought by vendor to the identified site.
- 6.2 It is the vendor's responsibility to inspect and assess a-priori, the civil work done by ISRO at the installation mark as per the projected requirements.
- 6.3 It is also the responsibility of the vendor to raise the support structure of the dome at the installation site. It is fully the responsibility of the vendor to transport all the subsystems and assemblies without any damage.

The post installation on-site tests shall include:

- 6.4 Mount mobility tests and telescope mobility tests in its installed mount.
- 6.5 Optical performance test integrated with CCD camera in the telescope mount.
- 6.6 Magnitude test based upon star observation.
- 6.7 Remote operability tests.
- 6.8 Detection of unknown object and registration.
- 6.9 Survey mode of operation.

On successful completion of the site acceptance tests, competent ISRO personnel shall certify the final acceptance of the system.

7. Support infrastructure and Essential Spares

The vendor shall provide a dedicated package of infrastructure along with the equipment.

- 7.1 The system should be capable of continuous operation for a minimum period of two days.
- 7.2 The system should be designed for a minimum operational life of 10 years and vendor shall identify the parts, which require replacement during this period by providing a maintenance chart.
- 7.3 Standard tools, tool holders and fixtures that form part of the telescope system, the control system and other related systems.
- 7.4 Fixture for removal and assembly of mirrors for coating shall be provided.

- 7.5 All essential spares for the system shall be listed out to ensure smooth functioning of the telescope (trouble-free operation) for a period of 10 years including 3 years of warranty period.
- 7.6 Vendor shall exclusively list out spares, tools and fixtures, which will be provided along with the system.
- 7.7 Requirements of civil, electrical etc. that is to be carried out by ISRO shall be specified within 30 days of acceptance of firm order so that these activities can be completed well in advance.

8. Quality Standards

International standards shall be followed while selecting materials, components and equipment used in realizing the system. The manufacturer shall mention the standards followed (eg. MIL std., Industry std.,).

- 8.1. All materials used in the realization of the system shall be provided with Certificate of Compliance (CoC).
- 8.2. The test certificates issued for components, subsystems and the overall system shall have traceable standards.

9. Major Milestones

- 9.1 Detailed design review
 - 9.1.1 The timeframe for submission of the DDR is 30 days from the date of receiving the P.O.
 - 9.1.2 DDR review at Bengaluru within 40 days from the date of receiving the P.O.
 - 9.1.3 Design correction / review recommendation implementation in the DDR review report and provision of vendor inputs for infrastructure realization should be within 50 days from the date of receiving the P.O.
- 9.2 Sub System Readiness
 - 9.2.1 Optical element readiness:

- 9.2.1.1 Readiness of Primary mirror/ Secondary mirror and other Optical elements within 6 months after the clearance of DDR (230 days from the date of release of the P.O)
 - 9.2.1.2 Presentation of certificate of compliance Lenses before assembly within 10 days after the readiness of Optical elements (240 days from the date of release of the P.O)
- 9.2.2 Assembly of Telescope subsystem: Within 1 month after the clearance of optical elements (270 days from the date of release of the P.O)
- 9.2.3 Telescope System Level specification check in factory. Within 10 days after the assembly of telescope subsystem (280 days from the date of release of the P.O)
- 9.2.4 Telescope Track Mount Major Sub Assemblies:
 - 9.2.4.1 Bearings, Motor, and Encoder - Readiness and certification within 100 days after the clearance of DDR (150 days after the release of PO.)
 - 9.2.4.2 Mechanical Elements – readiness and certification Within 5 Months after the clearance of DDR (200 days after the release of PO)
 - 9.2.4.3 Track Mount Assembly and performance check and certification within 7 Months after the clearance of DDR (260 days after the release of PO)
- 9.3 Telescope integration to Track mount: The telescope system integration to Track mount and system level performance check and certification should be within 9 Months after the clearance of DDR (320 days after the release of PO)
- 9.4 CCD camera: Readiness and certification should be within 7 Months after the clearance of DDR (260 days after the release of PO)
- 9.5 Integration of CCD camera: Integration of CCD camera to the telescope system and system level performance check and certification should be within 9 Months after the clearance of DDR (320 days after the release of PO)

- 9.6 Packing, forwarding and delivery of Telescope assembly along with Track mount should be within 11 months after the clearance of DDR (380 days after the release of PO)
- 9.7 Dome Assembly:
- 9.7.1 Readiness, factory acceptances test and certification should be within 7 Months after the clearance of DDR (260 days after the release of PO)
 - 9.7.2 Packing, forwarding and delivery of Dome assembly along with Track mount should be within 8 months after the clearance of DDR (290 days after the release of PO)
 - 9.7.3 Installation and certification of Dome assembly at site should be within 10 months after the clearance of DDR (350 days after the release of PO)
- 9.8 Software readiness: Should be made ready in parallel with the Hardware and the same should be demonstrated along with the sub system level performance checks and certifications.
- 9.9 Final installation, performance demonstration, training and Commissioning of the facility should be completed within 14 months after the clearance of DDR (470 days after the release of PO).

Note:

Certification of each item will be done by the review committee formed by ISRO with experts from the field. The vendor should provide all the relevant test results, measurements, and test sequences / procedure followed in detail prior to certification and send to the committee to study, at least 10 days before the certification meeting. Deviations if any during the execution of the project has to be brought to the notice of ISRO and vendor shall seek the approval of ISRO before proceeding with further activities.

10. Training

Two engineers and one technician identified by ISRO each from Optics, Mechanical and Electrical disciplines will have to be involved right from the stage of installation and should be trained in every aspect of operation and

maintenance of the system. All required training manuals to be provided during training.

11. Warranty

- 11.1. The vendor shall provide standard comprehensive warranty of the system for a period of 3 years from the date of installation and acceptance of the system.
- 11.2. The vendor should ensure that the items procured from external vendors also should have the guarantee period to cover the warranty of 3 years.
- 11.3. Vendor shall also firmly state the Annual Maintenance and Services (AMS) required for the installed system for a period of 3 years upon expiry of standard comprehensive warranty of 3 years and should quote for the same.
- 11.4. The vendor is required to exclusively provide information on the nature of maintenance and service to be performed periodically for smooth operation of the system during warranty and AMS.
- 11.5. The vendor shall also propose indigenous service provider if available for maintenance related activities.
- 11.6. The vendor shall provide the details of spares required for the smooth running of the facility for a minimum period of 10 years

12. Documentation

- 12.1. All manuals related to installation, operation and maintenance of the facility including all the major systems
- 12.2. Electronic versions of documentation shall be provided.
- 12.3. Process and quality control documents
- 12.4. Test and Evaluation documents related to the components, subsystems and the overall assembly
- 12.5. List of materials that have been used to realize the telescope system
- 12.6. List of subsystems
- 12.7. Procurement details for items not manufactured by the prime supplier
- 12.8. Process/Operation flow chart indicating process monitoring stages of the system
- 12.9. Handling/operational details of the system
- 12.10. Maintenance
- 12.11. Procedure for removal / recoating/ re-fixing of mirrors etc.

- 12.12. Access to source code shall be provided for the telescope control software to facilitate maintenance and trouble shooting.
- 12.13. Vendor shall provide the documentation regarding the software features and operating manuals.
- 12.14. The engineering documentation shall include built mechanical layouts and mechanical drawings/interfaces, and complete identification of all replaceable components or units, built drawings of all electronics, wire and timing diagrams as appropriate of all electrical and electronic interfaces. It shall also include results of modeling or simulations used in verifying the design.

13. Monitoring and Coordination

Vendor shall submit a monthly progress report of the progress of activities to ISRO to inform of the status of major works and delays, if any. Technical problems shall be brought to notice of ISRO for necessary approval. Any change in agreed upon plan shall be with the consent of ISRO. Vendor shall identify a single focal point each for coordination of technical and commercial activities on email basis. Likewise, ISRO shall identify a single focal point for all technical reporting and one for commercial reporting purposes.

14. Vendor Heritage

- 14.1 Prospective vendor should have previous experience of supply, installation and commissioning of similar photometry system for debris tracking in other locations.
- 14.2 Documentary evidence of supply, installation and successful functioning of similar photometry system for debris tracking within the time mentioned in this RFP in other locations should be produced along with the quotation.
- 14.3 Since the proposed facility is to be commissioned on a turnkey basis within a stipulated time frame, the vendor who do not possess the heritage shall not be considered for the proposal.

15. Quotation format

Vendor is required to prepare the quotation in two parts namely, Technical Quotation and the Commercial (Price) Quotation in two separate parts.

Technical Bid: The Technical offer shall contain the Technical Specifications, Compliance/Non-compliance, Justifications for Compliance/Non-compliance against the technical requirements, Technical Data sheets and any other technical information related to the offer made by the vendor. Vendor is required to prepare and provide the 'Technical Compliance Matrix' against each tender specification supported by technical data sheets and justifications with comments/remarks. A masked price bid of the technical offer shall be provided to decide and finalize the list of mandatory and optional deliverables along with the required spare and accessories. All the technical related documents shall be uploaded in the ISRO- EGPS (E- Governing Portal System) technical bid. The party shall mandatorily provide the compliance in EGPS also. **Revealing of price details along with technical offer will lead to rejection of the offer.**

Price Bid (EGPS): The cost of the individual items shall be quoted in the price bid of EGPS. The Commercial (price) quotation shall provide break-up of price for all the individual major items including spares, accessories and optional items commensurate with the RFP specifications as per EGPS price bid. Bunching of major or other deliverables shall be strictly avoided in order to have transparency and a fair evaluation of the bids. The cost break up of offer, if required, can be detailed in 'bill of materials' enclosed in commercial bid (EGPS-price bid) only.

16. General Instructions, Terms and Conditions

16.1 A potential vendor shall quote for complete optical system package including the telescope, telescope drive, dome, telescope mount, telescope control software, sensors etc. and the enclosure including installation and commissioning. Partial quote for some sub-systems are not acceptable and shall not be entertained.

16.2 Alternatively, the vendor may out-source part of the requirements to others (either locally or from outside) but with the condition that the vendor is solely responsible for end-to-end realization of the scheme that is proposed. The manufacturer's name and make of the product along with specifications shall be provided as part of the offer.

16.3 The heritage of all the systems shall be provided by the vendor.

16.4 Technical compliance chart of specifications with respect to RFP to be provided as shown in a sample format.

16.5 Background and experience of the company for carrying out installations of similar nature should be provided.

16.6 In the compliance matrix all the points mentioned in the RFP to be covered. Annexure-II provides the list of deliverables, additional information and AMSC.

Format for Compliance Matrix

Sl. No	Parameters as per RFP	Specifications	Vendor * responses on specifications	Test method / Stage	Schedule of validations / of results Delivery	Remarks

- Vendor response on specifications of each parameter should be elaborate & wherever possible quantitative figures to be provided. Simple statement writing complied should be avoided.

Terms and Conditions

- 16.7 Bidder, while submitting price bid, shall consider all domestic taxes & duties applicable, other costs, if any, to arrive at total landed cost. Hence, the bid shall be evaluated on total landed cost. While working out taxes & duties bidder also shall consider following exemption:
- 16.8 LEOS is eligible for availing Concessional GST in terms of Government of India (GOI), Ministry of Finance, Department of Revenue Notification No:45/2017-Central Tax [rate] dated 14.11.2017 and Notification No:47/2017-Central tax[Rate] dated 14.11.2017 and as per the same applicable percentage of GST is 5% under the scope of this tender. RFP Information Proprietary to LEOS/ISRO
- 16.9 LEOS shall provide Custom Duty Exemption Certification (CDEC) under Notification No. 50/2017 dated 30/06/2017 amended vide Notification No:5/2018 dated 25/01/2018 for SI No: 539A, Customs duty charges 5% of total order value.
- 16.10 Quote on High Sea Sales (HSS) basis shall not be accepted, since installation is involved.
- 16.11 "In case of overseas bidder, they may consider sourcing local content/services through domestic agency (India) and indicate release of separate order on such named entity. Quote for such sourcing/ services shall be in INR (Indian currency) considering all domestic taxes & duties. In such cases over all responsibilities lies with prime bidder (OEM/SI)."
- 16.12 The bidder shall provide breakup cost of all deliverables in the price bid making use of narration column of "other costs" field and values of the same should not be reflected in the "value" column. Other costs, if any, should only be mentioned in the value and corresponding narration shall be distinctly mentioned in the narration column of "other costs".
- 16.13 The bidder shall provide breakup of foreign currency portion & Indian Rupees portion of the total cost, if required on request of Purchaser.

Transportation/Logistics

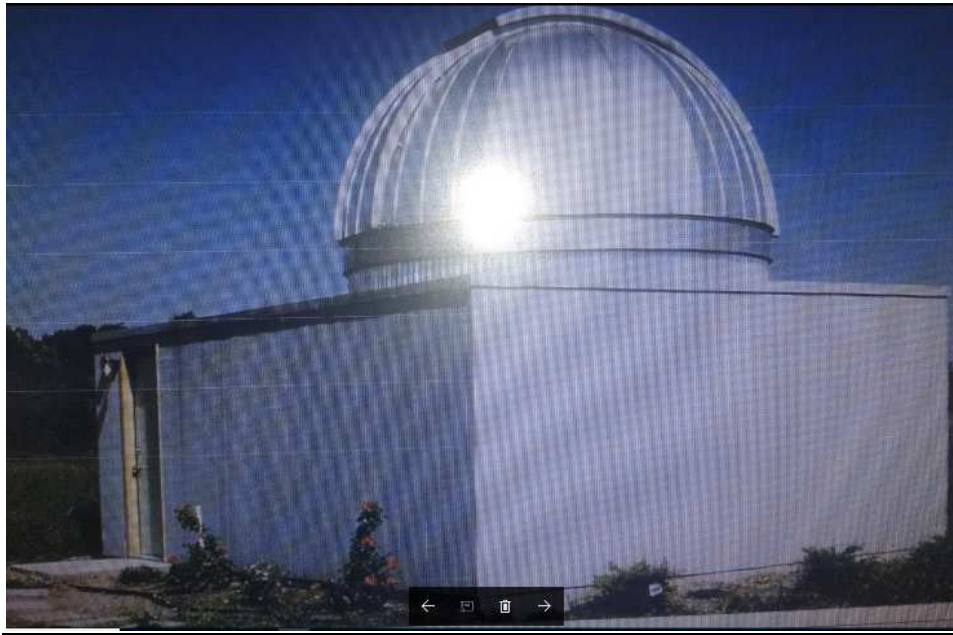
- 16.14 Successful bidder shall be responsible for the safe transportation/delivery of total system to actual sites at Hanley (Site identified by LEOS) and shall include clearance of imported equipment from the customs. The items belong to LEOS shall be directly delivered to Hanley and items belongs to LEOS, Bengaluru.
- 16.15 Successful Bidder shall also be responsible for all logistic arrangements like Custom clearance, boarding/lodging for the installation-team of the bidder, etc. No cost shall be borne by the Purchaser till final acceptance of the system except the Purchaser furnished items. The RFP for Netra Telescope Systems is an Information Proprietary to LEOS/ISRO.

Delivery/ Payment Terms:

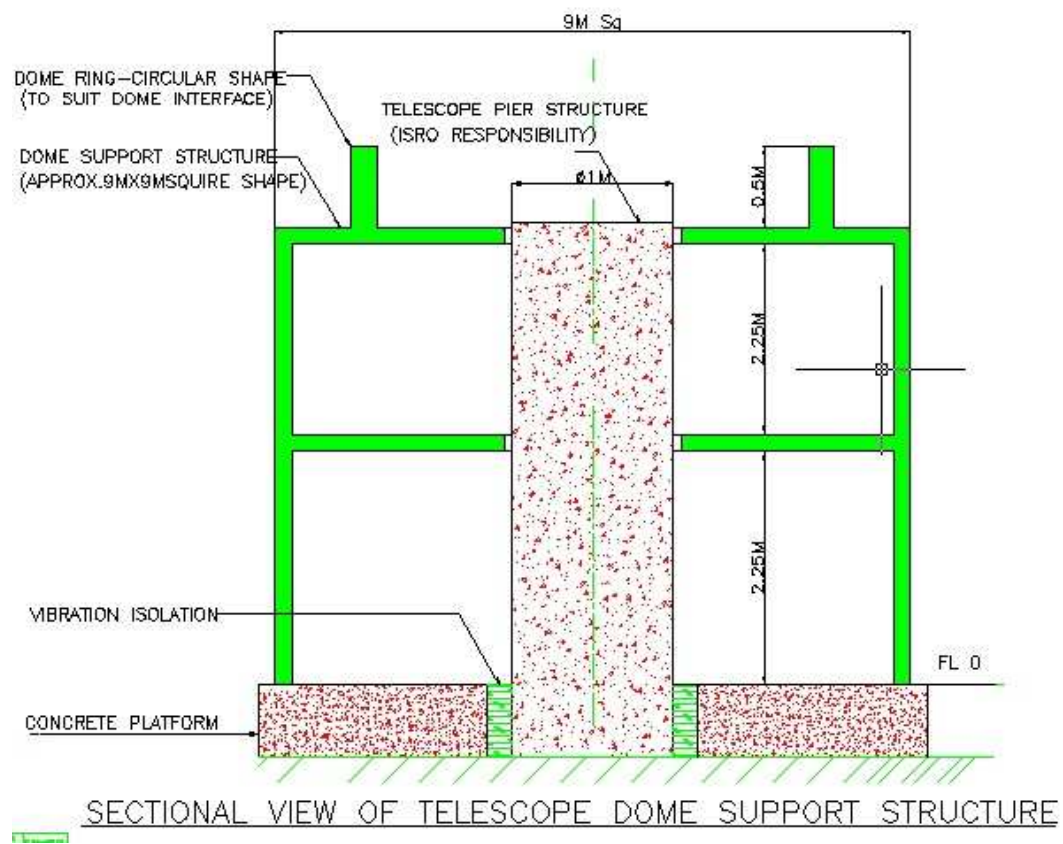
- 16.16 Delivery Terms: The Price shall be on FOR DESTINATION (Hanley, India). In case of imports appropriate INCOTERM shall be used.
- 16.17 Taxes and Duties applicable and payable shall be indicated separately
- 16.18 Security Deposit: 10% of the total order value to be deposited as security deposit within 15 days of signing of contract/PO date to ensure faithful execution of work in time. If successful bidder fails to execute the order, this amount will be forfeited for non-adherence to contractual terms. This shall be valid till the date of acceptance with a claim period of two months.
- 16.19 Performance Guarantee: The successful bidder shall guarantee satisfactory performance/ operation of the commissioned system under the conditions and for the services specified during warranty period. As a performance security, the successful bidder shall furnish Performance Bank Guarantee (PBG) for an amount of Ten percent (10%) of the total order/contract value from a Scheduled Bank, valid till the end of warranty period with a claim period of two months on acceptance of full

Annexure - I

Typical Dome support room structure photo



Typical Dome support room structure typical dimensions



Annexure –II

1. Bill of Materials

- 1.1. Optical Telescope with accessories-1 Set.
- 1.2. Telescope mount with accessories -1 Set.
- 1.3. Camera with accessories – 1 Set.
- 1.4. Dome with accessories -1 Set.
- 1.5. Weather Station Equipment with accessories -1 Set.
- 1.6. Dome support room structure with accessories - 01 Set.
- 1.7. Any other items required to complete the Scope of work- As required.
- 1.8. Special tools and instruments required for the operation.
- 1.9. Spares -as required.

Note:

1. The offer for complete scope is only considered and partial and incomplete offers will be rejected.
2. **The technical bid should not contain any price (details) of the offered product(s). if do so, the offer will be rejected without any communication. The party shall provide the cost break up of all above items in the enclosed 'bill of materials in commercial bid' (price bid) only.**
3. The party shall mandatorily submit offer for Sl. No: 1.6 Dome support room structure with accessories. However, LEOS- ISRO is at discretion may or may not place order.
4. The offer for spares required for minimum of 10 years trouble free longtime operation of the system to be provided separately. The list of spares offered by the party shall be provided in the technical bid. ***The cost breakup of the spares shall be provided in the 'enclosed bill of materials' in the price bid and the total cost of the spares shall be provided in the main price bid.*** Offers without essential spares will not be considered. However, LEOS solely at its discretion may order complete spares or part thereof or nil depending upon the requirement.
5. The party can submit the offer for any other the items that are required to complete the scope of work with justification. However, LEOS- ISRO, at

discretion may or may not consider the offer depending the upon the requirement.

2. AMSC (Annual Maintenance Service Contract)- Comprehensive including Calibration

- 2.1. Scope: The scope of AMSC is complete comprehensive and any materials/products/software required to keep the system operational and healthy as per specification is complete scope of the vendor. The scope also includes up-gradation/modification of software/system, if required with consent of LEOS-ISRO.
- 2.2. The Comprehensive AMSC will start after expiry of warranty period
- 2.3. The period of comprehensive AMSC is for three years.
- 2.4. The Annual Maintenance Service contract shall cover one calibration and one preventive maintenance per year and unlimited number of breakdown visits during the AMSC period. During preventive maintenance visit, the party shall check system performance, functional parameters and provide the report. During calibration, the vendor shall make the system confirm to the specification, conduct calibration and issue certificate.
- 2.5. In case of any issues/breakdown/service, the party shall attend to them within seven working days after intimation.
- 2.6. The party shall submit offer for comprehensive AMSC for three years. However, LEOS at its discretion may order AMSC for three years or two years or one year or nil. Payment will be made on successful completion of scheduled services.